

## **Measure 1: Transit Travel Time**

### **Monitoring Objectives**

The purpose of monitoring transit travel times is to answer the following questions regarding transit travel times on surface streets in the Seattle Central Business District (CBD) before and after tunnel closure:

- How long are the transit travel times in the Seattle CBD?
- How consistent are the transit travel times in the Seattle CBD?
- Where are slowdowns occurring and are there mitigation measures that might address these slowdowns?

### **Methodology**

Transit travel times were measured using roadside bus detection equipment at 16 locations in the Seattle CBD. The locations of these detection points are identified in Figure 2. A description of the equipment and technology can be found in the Methodology section of the baseline tunnel closure report.

The collection of transit travel times began in summer 2005 and will be continuously collected throughout the tunnel closure period. Two levels of data are included in the regular performance reports issued by the Monitor and Maintain Committee:

Level 1: Seattle CDB summary statistic is a high level summary of transit travel time for all bus movements. It consists of aggregated travel times through the study area to define an average transit operating time in the Seattle CBD for the AM peak and the PM peak. This measure will show the amount of time a bus takes on average to traverse the downtown area. Over time, this measure will identify the overall trend in the increase or decrease in delay caused by tunnel closure.

Level 2: Transit Corridor Travel Time summary will track travel time along specific transit corridors in the central business district. The transit corridors included in the monitoring are identified in Figure 2. The data will be categorized by corridor and by time of day (AM peak and PM peak). Variability of the data will also be reported to show the consistency of transit travel times.

**Figure 2. Transit Travel Time Summary Analysis Corridors and Detection Point Locations**



## Transit Travel Time Comparison

Data of transit travel time post tunnel closure is collected continuously. For this report, weekday travel times between October, 2005 and November, 2005 were used. The first week after tunnel closure and the holiday season beginning Thanksgiving day are not considered to be comparable conditions to the before tunnel closure report data. Time of day periods, monitoring locations and analysis tiers are the same as the baseline report except where noted.

In general, transit travel time averages on surface streets after tunnel closure were within one minute of the pre-closure baseline on the north-south. On Third Avenue, conditions for transit improved noticeably; east-west travel times on Stewart and Virginia Streets were notably slower compared to the baseline. These conditions were identified soon after tunnel closure and additional mitigation actions were taken. The additional mitigation will be assessed after they are completely implemented, and the effectiveness of these measures will be reported in the next report.

### Seattle CBD Travel Time Summary (Level 1):

The first level of analysis for downtown transit travel time is a composite measurement of average time spent in the study area on surface streets. This value is obtained by identifying the first and last observation of a bus trip in the CBD, regardless of the corridor. Averaging this figure for all trips results in a single value of time spent in the CBD for all observed trips.

This value is used as an index, not a measure. This figure includes all time expended in the central business district including layover time as well as all time spent in service. It also reflects many different paths through the CBD with different lengths and travel conditions. The measure becomes meaningful when compared to the same measurement in the future to compare the ease of travel for transit through the CBD.

The baseline Travel Time Index is **100**, representing the value before tunnel closure. The average travel time value for transit routes operating on surface streets was 21:59 minutes, based on bus trips between 4-6 p.m. on weekdays during the month of July. The Travel Time index after tunnel closure is **111** based on trips between 4-6 p.m. during October and November. This represents an **11 percent** increase in time spent in the CBD on surface streets. Most of the increase can be attributed to the increased travel times on Stewart and Virginia Streets, and the additional time required to operate tunnel routes on surface streets. A comparison of the schedule time allocated to route segments in the CBD corroborates this 11 percent increase in travel time. Between the June 2005 and September 2005 service changes, there was an 11.8 percent increase in scheduled time for downtown routes. This increase was a planned mitigation measure and required an investment of approximately 45,000 annual hours of service, at an estimated annual cost of \$4.5 million.

### Transit Corridor Travel Time Summaries (Level 2)

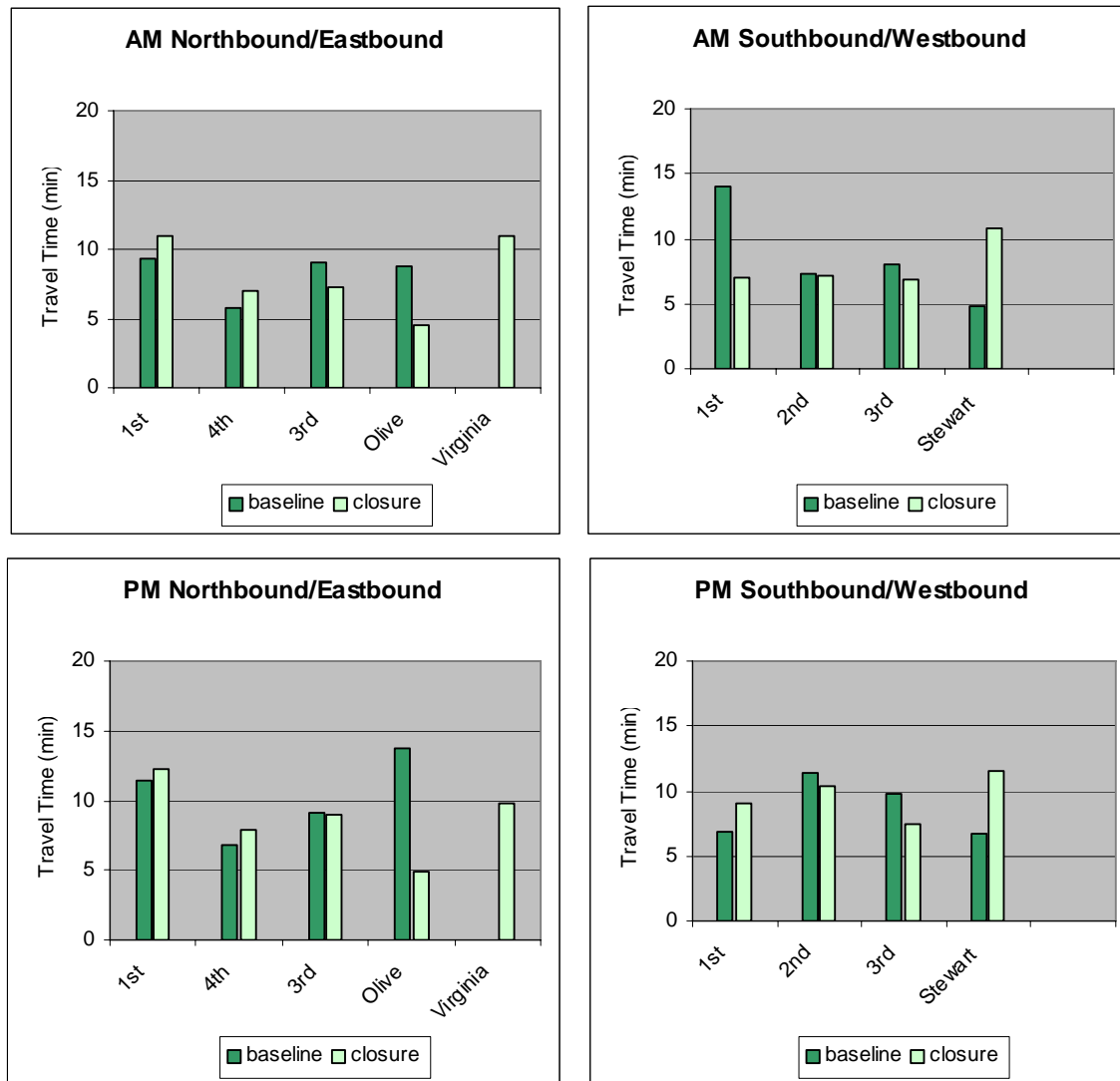
The four charts in Figure 3 show the average travel times for transit on selected segments of the surface streets in the CBD after tunnel closure. The data was collected in October and November of 2005 using the monitoring system. The data used is from weekdays only, and does not include data from during or after the Thanksgiving holiday. Each chart shows the average travel time for the direction of travel and time of day indicated. The AM charts include buses observed between 7 - 9 a.m. at the first reader on the corridor being measured. The PM charts cover the time period from 4 -6 p.m..

The corridor average travel times are compared to the comparable baseline measurements. Corridor travel times should not be compared to each other. Readers were placed to ensure route coverage. Readers were also sited to facilitate communications and insure access to power. As a result, the measured corridors differ in length, number of stops and number of signals, all of which affect travel time but are not related to congestion. The corridor boundaries and baseline and after closure measurements are described below.

The reader locations that define the boundaries of each of the transit corridors are described below along with a table for each corridor that summarizes the Average Travel Time by time period along with the standard deviation (SD) of the observations in minutes. As a statistical measure, approximately 69 percent

of all observations are within one standard deviation of the average. The SD can be interpreted as approximating the range (+/- SD) of the typical travel time that a majority of bus riders will experience on the corridor.

**Figure 3. Transit Corridor Travel Time Before and After Tunnel Closure**



**Figure 4A. First Avenue Transit Travel Time and Variation**

**First Avenue**

Northbound, Royal Brougham to Seneca Street

**AM Peak (7 – 9 a.m.)**

Travel time:  
Baseline: 9 min 22 sec (SD: 4.8 min)  
Closure : 10 min 54 sec (SD: 5.8 min)  
Change : +1min 32 sec

**PM Peak (4 – 6 p.m.)**

Travel Time:  
Baseline : 11 min 24 sec (SD: 5.3 min)  
Closure : 12 min 12 sec (SD: 6.0 min)  
Change : +48 sec

Southbound, Seneca Street to Royal Brougham<sup>1</sup>

Travel time:  
Baseline: 14 min (SD: 8.8 min)  
Closure : 7 min (SD: 5.4 min)  
Change : -7min

Travel time:  
Baseline : 6 min 51 sec (SD: 3.9 min)  
Closure : 9 min 6 sec (SD: 6 min)  
Change : +2 min 15 sec\*\*

<sup>1</sup> The comparison of baseline data with post tunnel closure data for on First Avenue shows a significant change in southbound travel time in the AM period. However, the baseline averages were based on relatively few observations and may not be accurate due to a small sample size. Closure data is based on

many more observations, and is more accurate. Given the change in the northbound direction, southbound travel times in both directions are most likely one to two minutes slower than before tunnel closure.

**First Avenue** (Northbound and Southbound) reader locations are Royal Brougham to the south and Stewart Street to the north, with a midpoint at Seneca Street. The initial travel time measurements are for the segment between Seneca Street and Royal Brougham only because of delays in powering the Stewart Street reader. For consistency, the closure data measures the same start and end points as the baseline report. Future reports will transition to the full corridor definition.

**Figure 4B. Second Avenue Transit Travel Time and Variation**

Second Avenue	AM Peak (7– 9 a.m.)	PM Peak (4– 6 p.m.)
Southbound, Pike Street to S Jackson Street	Travel time: Baseline : 7 min 20 sec (SD: 1.9 min) Closure : 7 min 13 sec (SD: 2.6 min) Change : - 7 sec	Travel time: Baseline : 11 min 26 sec (SD: 4.3 min) Closure : 10 min 26 sec (SD: 3.5 min) Change : -1min

**Second Avenue** (Southbound only) reader locations are Pike Street and S Jackson Street with a midpoint at Seneca Street. Second Avenue maintained the same average travel time with slightly more variation in the AM peak. In the PM peak, average travel times improved by one minute in average and variation. The PM peak improvements could be attributed to the end of the baseball season and the slight reduction of transit trips during the peak.

**Figure 4C. Third Avenue Transit Travel Time and Variation**

Third Avenue	AM Peak (7– 9 a.m.)	PM Peak (4– 6 p.m.)
Northbound, Yesler Way to Stewart Street*	Travel time: Baseline : 9 min (SD: 4.6 min) Closure : 7 min 20 sec (SD: 3.1 min) Change : -1min 40 sec	Travel Time: Baseline : 9 min 6 sec (SD: not available) Closure : 8 min 57 sec (SD: 3.6 min) Change : - 9 sec
Southbound, Stewart Street to Yesler Way	Travel time: Baseline : 8 min 5 sec (SD: 1.3 min) Closure : 6 min 52 sec (SD: 2.8 min) Change : -1min 12sec	Travel time: Baseline : 9 min 45 sec (SD: 2.5 min) Closure : 7 min 27 sec (SD: 2.9 min) Change : -2min 18sec

**Third Avenue** (Northbound and Southbound) reader locations are Stewart Street to the north, and Yesler Way to the south, with a midpoint at Seneca Street. Average travel times improved in both directions and in both peak periods after tunnel closure due to traffic restrictions and transit lanes implemented on the corridor.

In addition, a special travel time study of Third Avenue was conducted in November, 2005 to assess the impact of reducing the hours of peak restrictions by 30 minutes to start at 6:30 a.m., rather than 6 a.m. and to end at 6:30 p.m., rather than 7 p.m.. It was determined that the proposed change in AM peak restrictions would be detrimental to transit, particularly given the increase in bus volumes along Third Avenue that take place in this 30 minute period. However, the change in the PM restrictions was judged to be acceptable. No impact was projected and once the reduced PM restrictions were implemented on November 21, 2005, no negative impacts were observed. This is due to the significantly lower volumes of buses and general traffic in the 30 minute period between 6:30-7 p.m.

**Figure 4D. Fourth Avenue Transit Travel Time and Variation**

Fourth Avenue	AM Peak (7– 9 a.m.)	PM Peak (4– 6 p.m.)
Northbound, S Jackson Street to Seneca Street	Travel time: Baseline : 5 min 48 sec (SD: 1.2 min) Closure : 6 min 58 sec (SD: 2.8 min) Change : +1min 10 sec	Travel Time: Baseline : 6 min 46 sec (SD: 1.1 min) Closure : 7 min 50 sec (SD: 4 min) Change : +1min 4 sec

**Fourth Avenue** (Northbound only) reader locations are Seneca Street to the north and S Jackson Street to the south. Average travel times increased by one minute during both the morning and evening peak periods, with notably more variation.

As noted above, there have been minimal changes in peak hour transit travel time on the north-south surface streets. However, the routes that previously operated in the tunnel now experience much longer running times when compared to the eight minutes it formerly took them to travel from the International District station to the Convention Place station via the tunnel. Depending on routing, time of day and direction of travel, trips through the central business district on former tunnel routes can take 14 to 23 minutes longer. The tunnel also offered a highly reliable trip. Surface operation for these former tunnel routes is both longer and considerably less predictable.

**Figure 4E. Olive Way and Virginia Ave Transit Travel Time and Variation**

	AM Peak (7 – 9 a.m.)	PM Peak (4 – 6 p.m.)
Eastbound Virginia, Third Avenue to Ninth Ave	Travel time: Closure : 10 min 39 sec ( <i>SD: 5.1 min</i> )	Travel Time: Closure : 9 min 50 sec ( <i>SD: 4.9 min</i> )
Eastbound Olive Way, Third Avenue to Eighth Ave	Travel time: Baseline : 8 min 42 sec ( <i>SD: 9.1 min</i> ) Closure : 4 min 34 sec ( <i>SD: 2.4 min</i> ) Change : -4min 8 sec	Travel Time: Baseline : 13 min 43 sec ( <i>SD: 9.7 min</i> ) Closure : 4 min 51 sec ( <i>SD: 2.5 min</i> ) Change : -8min 52 sec
Eastbound Howell, Eighth Ave to Yale Street	Travel time: Baseline : 2 min 6 sec ( <i>SD: 1.4 min</i> ) Closure : 3 min 53 sec ( <i>SD: 2.4 min</i> ) Change : +1min 47 sec	Travel Time: Baseline : 5 min 25 sec ( <i>SD: 3.1 min</i> ) Closure : 5 min 37 sec ( <i>SD: 3.3 min</i> ) Change : +12 sec

**Virginia Street** (Eastbound only) reader locations are Third Avenue at Stewart to the west and Ninth Avenue at Stewart to the east. Virginia Street was not a transit routing before the tunnel closure, so there is no baseline data. This corridor is two blocks longer than the parallel Olive Way with an additional turn. However, compared with baseline data for Olive, Virginia is slower in the AM peak but faster, with less variability in the PM peak.

**Olive Way** (Eastbound only) reader locations are Third Avenue to the west and Eighth Avenue to the east. Average travel times decreased dramatically on Olive Way between Third and Eighth Avenues. Travel time variation improved as well.

**Howell** (Eastbound only): Transit on Howell east of Eighth Avenue slowed in the AM but was still more than a minute faster than the PM average which stayed even after tunnel closure.

**Figure 4F. Stewart Street Transit Travel Time and Variation**

	AM Peak (7 – 9 a.m.)	PM Peak (4– 6 p.m.)
Westbound, Ninth Avenue to Third Avenue	Travel time: Baseline : 4 min 50 sec ( <i>SD: 1.9 min</i> ) Closure : 10 min 52 sec ( <i>SD: 5.2 min</i> ) Change : +6min 2 sec	Travel Time: Baseline : 6 min 42 sec ( <i>SD: 1.5 min</i> ) Closure : 11 min 36 sec ( <i>SD: 4.9 min</i> ) Change : +4min 54 sec

**Stewart Street** (Westbound only) reader locations are Third Avenue to the west and Ninth Avenue to the east. Average travel time on Stewart Street approximately doubled increasing 6 minutes in the AM peak, and 5 minutes in the PM peak. Variation also increased dramatically. The baseline data on this corridor was a different data source due to equipment difficulties, but the results are consistent with field observations comparing before and after conditions.